

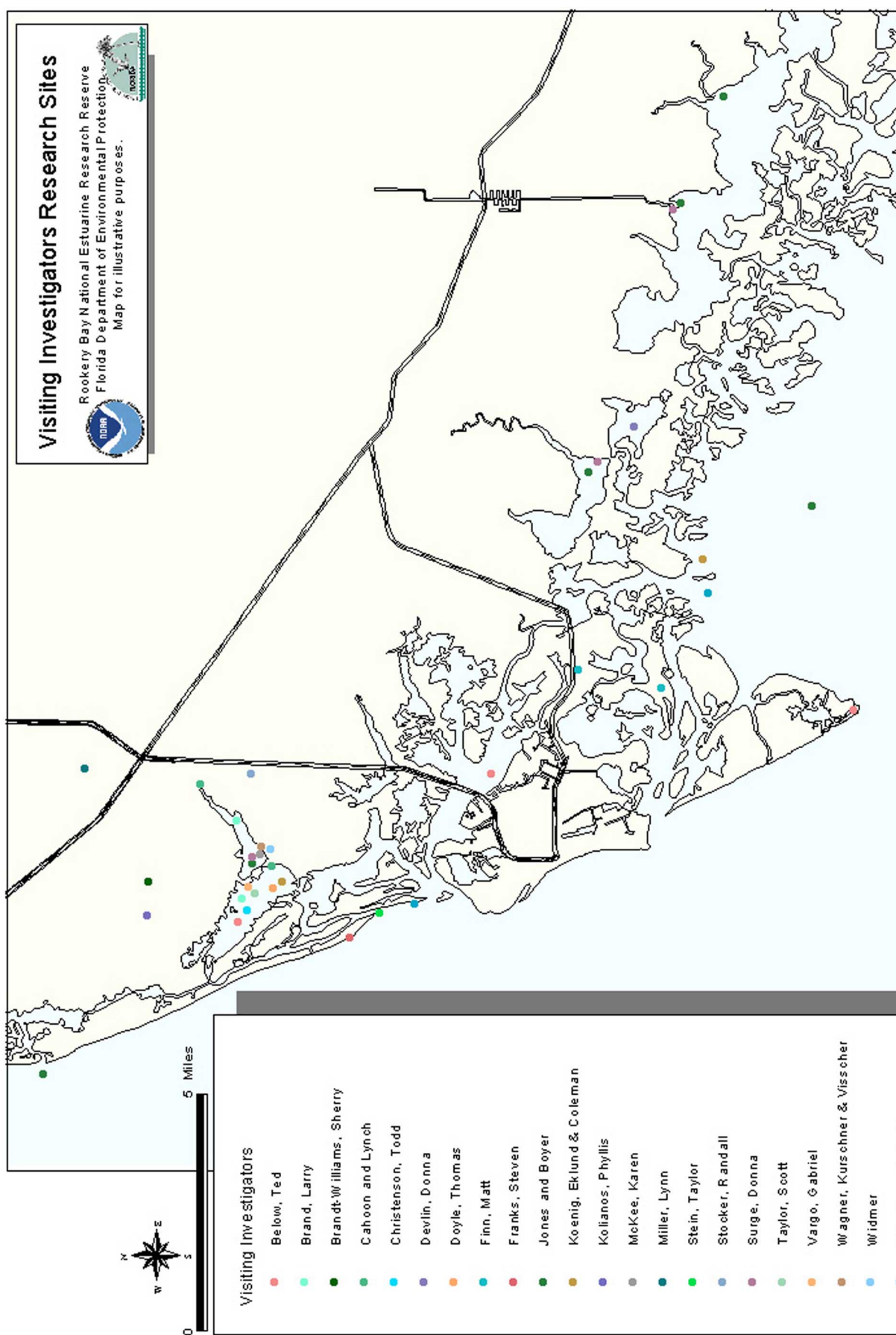
Visiting Investigators

A key RBNERR goal is to facilitate and support research in the Reserve conducted by visiting investigators, through partnerships with universities, research institutions and agencies. The Reserve continues to expand facilities and equipment to support visiting investigators at Rookery Bay. In addition to establishing two research field stations with overnight accommodations and boat access at Cannon Island and Goodland, RBNERR offers two graduate fellowships per year, with NOAA support. A recently established partnership with Florida Gulf Coast University (FGCU) has resulted in an increase in student and faculty research and courses conducted at the Reserve. The proposed RBNERR Environmental Learning Center facility, including two research laboratories and a wet lab, will significantly increase visiting research opportunities at the Reserve by universities and research institutions.

The Goodland/10,000 Islands and Cannon Island Field Research Stations were established to provide facilities support and overnight accommodations to individuals conducting research, education, resource management or other projects consistent with the goals and objectives of RBNERR and FDEP. In addition to housing, boats, vehicles, lab and field equipment are available for use by visiting investigators. Policies and guidelines providing information on facilities, usage, fees, equipment and scheduling are included in the Visiting Investigators Registration Worksheet available on the CD as a PDF file for your convenience.

Much of the research completed at RBNERR has been published in journals, technical government reports, dissertations and thesis. Some are available only as draft summaries or project reports from consultants. All of these documents are listed in the bibliography, and will soon be available as retrievable documents.

An abridged listing of projects lead by visiting investigators is provided here as examples of ongoing research in the Reserve and the surrounding Aquatic Preserves. These summaries have been provided by the principle investigator, with contact information provided. A map of areas included in ongoing research is also provided.





Projects are listed here by category of research. Project descriptions provided by these researchers follow and are arranged in alphabetic order by first researcher.

Project List

| Category | Study | Researchers |
|--------------------|---|---|
| Archeology | Archeological Resource Guide Field Excavations and Mollusc Dating | Phyllis Kolianos Randolph Widmer |
| Birds | Coastal Waterbird Populations in Southwest Florida | Theodore Below |
| Disturbances | Monitoring and Modeling Forest Structure and Productivity of Mangrove Ecosystems | Thomas Doyle |
| Dunes | Coastal Dune Plant Ecology and Restoration | Steven Franks |
| Fisheries | Jewfish population dynamics Monitoring and assessment of recovery of jewfish (<i>Epinephelus itajara</i>) populations in the eastern Gulf of Mexico Physical Anomalies in <i>Rivulus marmoratus</i> | Matt Finn Christopher Koenig, Anne-Marie Eklund, Felicia Coleman Scott Taylor |
| Invasives | Comparing Application Methods and Herbicides for Control of Downy Rose Myrtle | Randall Stocker |
| Invertebrates | Red Mangrove (<i>Rhizophora mangle</i>) Genetic Structure in the 10,000 Island Archipelago | Donna Devlin |
| Mangroves | Recent Accretion and Surface Elevation Change Relationships in Basin and Fringe Mangrove Forests at Rookery Bay, 1993-1995 & Vertical Accretion and Shallow Subsidence in a Mangrove Forest of Red Mangrove (<i>Rhizophora mangle</i>) Genetic Structure in the 10,000 Island Archipelago Monitoring and Modeling Forest Structure and Productivity of Mangrove Ecosystems Dieoffs, restoration and succession Root Production, Vertical Accretion, and Surface Elevation Change in Mangrove Forests | Donald Cahoon & James Lynch Donna Devlin Thomas Doyle Matt Finn Karen McKee |
| Paleoecology | Oyster shell isotope composition Leaf anatomical/morphological adaptations in (sub) fossil mangroves | Donna Surge Friederike Wagner, Wolfram Kürschner, Henk Visscher |
| Phytoplankton | Regulation of Estuarine phytoplankton dynamics: The interaction of reduced salinity, enhanced N:P ratios and | Gabriel Vargo |
| Public Access | Developing a Recreation Management Strategy for Rookery Bay National Estuarine Research Reserve | Taylor Stein |
| Restoration | Long-Term Monitoring of Impoundment Restoration | Sherry Brandt-Williams |
| Turtles, Tortoises | Gopher tortoise management, growth and distribution on Investigation of Immature Sea Turtles in the Coastal Waters of Southwest Florida | Matt Finn Wayne N. Witzell & Jeffrey R. Schmid |
| Water Quality | Chlorophyll and Nutrient Assays in the Ten Thousand Mesoscale spatial and temporal water quality trends in Rookery Bay Southwest Florida Estuarine Monitoring Network Reducing Phosphorous Loads to Lakes in South Florida: Testing an 8-Foot Vegetative Filter Strip | Larry Brand Todd Christenson w/G. Vargo Ronald Jones & Joe Boyer Lynn Miller |



Project Descriptions and Contacts

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For over the past 20 years I have been collecting, analyzing, and using data to achieve the following goal: to develop information, i.e. one large population study, of coastal waterbirds in Southwest Florida that can be used to assess the condition of the natural world, in what has turned out to be an area of major human impact. The following are projects that I have been working on: Brown pelican population study Marco Bay Complex, Rookery Bay sundown population study, ABC sundown population study, Brown pelican population study Naples Beach, Cape Romano shorebird study, Cape Romano shorebird banding project, Osprey breeding productivity, Least tern and black skimmer productivity and protection, and Colonial waterbird nesting.

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I have been measuring chlorophyll concentrations and conducting nutrient bioassays in the Ten Thousand Islands area, including Rookery Bay and Henderson Creek. Some of those data are being published in the following: Brand, L.E. 2001. The transport of terrestrial nutrients to South Florida coastal waters. In: Linkages between Ecosystems in the South Florida Hydroscape: The River of Grass Continues, Ed. By J.W. Porter and K.G. Porter (in press).



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Tracking Landscape and Ecosystem Dynamics as an Impounded Coastal Property is Reclaimed

Thirty years ago, a 222-hectare site bridging uplands and estuaries was impounded. A ditch and berm was constructed around the entire perimeter of the property for easier aerial sighting and access. Aerial photographs prior to impoundment show a surface connection between freshwater sloughs and tidal creeks at the center of the property. Recent aeriels and field surveys show a hydrological disconnection, new upland areas and many transitional communities. The property is being excavated to original elevations, with the purpose of restoring overland flow and tidal influence. Changes in salinity, soil moisture and elevation should eventually result in xeric community shifts to hydric and marsh to forested area transitions. A long-term succession study has been implemented to assess the consequences and process of transition at a landscape, ecosystem and community scale, and to direct future restoration management. Historical fragmentation has been evaluated using GIS tools, and future large-scale gradient changes and system alterations are being followed in a similar way. Specie counts and inventories, density measures and soil characteristics were conducted prior to restoration, documenting current ecosystems and communities. These will be compared to several nearby control sites periodically over the next ten years.

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Accretion and Elevation Change in the Mangroves of Rookery Bay, Florida

We currently are investigating the rates of elevation change and sediment deposition in the mangroves of Rookery Bay. Elevation is measured with a Sedimentation-Erosion Table (SET) and accretion is measured from artificial soil marker horizons. We use these data to estimate rates of subsidence of the mangrove sediments. Rates of elevation change are compared to local rates of sea-level rise to determine the potential for submergence of the mangrove forest. Since 1993, we have taken measurements in natural mangrove settings at Cat's Claw Trail (Fringe and Basin) and two small mangrove islands located nearby in the bay. Since 1997, we have been monitoring accretion and elevation change at the restoration site on Henderson Creek. Initial findings from the natural settings were published in Cahoon and Lynch 1997.



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Mesoscale spatial and temporal water quality trends in Rookery Bay

Bi-weekly measurements of surface and bottom values for temperature, dissolved oxygen, pH, salinity, conductivity, redox potential, and turbidity, as well as bottom depth and Secchi depth, for 19 stations in Rookery Bay, FL between 1986 and 1992 and bi-weekly measurements of nitrate, nitrite, ammonia, phosphate and chlorophyll for 7 of these stations from 1988 to 1992 were obtained from Dr. Tom Smith III, formerly of Rookery Bay National Estuarine Research Reserve. A variety of statistical methods were used to analyze the data sets including correlation analyses, t-tests, ANOVA, multiple regression, and principle component analysis. Correlation between turbidity and nutrients suggest that the sediments may be a source of nutrients and may ultimately derive from the decomposition of mangrove litter. Nutrient values overall do not indicate that eutrophication has occurred during the study period. Mean nutrient values were highest in 1988 and dropped precipitously thereafter. Furthermore, mean values were significantly lower overall than those reported by Grabe (1993) for 1988 and diverged even more sharply in 1989. Nitrate values were similar to those found by Thoemke and Gyorkos (1988) for the period of June 1984 to April 1985, though other nutrient species were elevated relative to those of Thoemke and Gyorkos (1988). Relative to other estuaries nutrient values are very low suggesting that the impact of increased development through 1992 did not increase eutrophication in Rookery Bay.

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Susan L. Grace, National Wetlands Research Center – USGS

*Red Mangrove (*Rhizophora mangle*) Genetic Structure in the 10,000 Island Archipelago*

The first goal of this research is to ascertain the genetic structure of the Red Mangrove in the upper TTI archipelago. Genetic structure will be addressed both in terms of inbreeding rate and genetic diversity within and among islands. Managers may find this knowledge invaluable when making decisions regarding recreational use of natural wildlife areas, restoration projects, the placement of limited protection devices in the case of a toxic spill, and in the management of disease outbreaks. The second goal is to determine the effect of the parasitic beetle, *Coccotrypes rhizophorae*, on the structure of the Red Mangrove population within the TTI National Wildlife Refuge. This experiment will add to our knowledge of the intricate relationships between coevolved species. Evidence suggests that the relationship this parasitic beetle and the Red Mangrove is consistent with geographic mosaic theory (Thompson 1994, 1999). According to Thompson's theory a mosaic of different outcomes between a pair of coevolved species occurs as a function of varying genetic structure, demographics and physical environments.



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Monitoring and Modeling Forest Structure and Productivity of Mangrove Ecosystems Research Activity at RBNERR

Dr. Doyle has conducted a fairly extensive research program to develop a stand simulator and landscape model of the greater Everglades system to examine the long-term impacts of hurricanes and sea-level rise on the health and distribution of mangrove communities of south Florida. Long-term forest plots were established at RBNERR to document forest structure and damage prior to and following hurricane Andrew. Data were used to correlate the degree of forest damage relative to predicted windspeed of hurricane Andrew and to incorporate empirical results into a mangrove forest model. A landscape simulation model has been developed that spatially distributes the stand level mangrove simulator across the south Florida peninsula. Model applications include a hindcast simulation of hurricane history and sea-level rise to review the role of changing climate in controlling forest structure and succession across the south Florida landscape. The modeling design for this project is unique in several ways, most notably the linking of multiple models of varying scale into a single application. This is the first modeling application of its kind linking hindcast simulations of actual hurricane tracks in conjunction with a spatially distributed forest simulation model. This work has increased our understanding of the important role hurricanes play in controlling the status and stature of mangrove systems of south Florida.

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Mangrove research includes: Forest studies ongoing since 1992, Long term monitoring of forest growth in 4 forest types, Mangrove dieoffs, Mangrove restoration with Conservancy; an ongoing FWS funded project. Fishery research includes: Ongoing studies of jewfish population dynamics since 1998 and Ongoing studies of terrapin population dynamics since 1999, both studies with NMFS. Water quality research includes: With NMFS, 6 month study on water quality of 3 canals and 6 rivers, Linkage of water quality with aquatic populations. Other research includes: Gopher tortoise management, growth and distribution on Horr's island with the Key Marco Community Association and FFWCC, ongoing since 1999.



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Coastal dune plant ecology and restoration

My research focuses on plant interactions in coastal dunes. I am conducting a series of studies examining the influence of stress and disturbance on competitive and facilitative interactions among dune plants at several different life stages at two field sites- Key Island, Florida and Sapelo Island, Georgia. Results thus far indicate that facilitation tends to increase with increasing stress and disturbance and to be most important at earlier life stages, as predicted by recent theoretical work. Adult dune plants facilitate the accumulation of seeds, but many of these seeds are of ruderals rather than later successional species. Germination of dune plants in the field is extremely low, and facilitation of germination or establishment by adult plants could not be detected. Burial can shift interactions from competitive to facilitative, but species diversity does not affect this relationship. The presence of neighbors increased the likelihood of survival but decreased the biomass of target plants. In summary, my work has shown that interactions among dune plants can be complex, but that facilitation does occur and is especially important under stressful conditions and at early life stages.

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Southwest Florida Estuarine Monitoring Network

This network consists of 28 fixed sites in Rookery and Estero bays selected as to integration and representation of area, diversity of ecosystem types (bay, channel, shore, etc.), overall spatial coverage of region, and access by small boat (logistics). Six of the sites are located at pre-existing physical monitoring sites in the NOAA Rookery Bay monitoring program. Monthly surveys are conducted to measure surface and bottom salinity, temperature, dissolved oxygen, and light extinction. Surface water samples are collected and analyzed in duplicate for pH, turbidity, nutrient content, and biological parameters. The nutrient parameters analyzed are ammonium, nitrate, nitrite, total nitrogen, soluble reactive phosphate, total phosphorus, and total organic carbon. Silicate is measured quarterly. The biological parameters measured are chlorophyll a and alkaline phosphatase activity. All sampling and analysis are performed as described in the SFWMD approved QAPP for this project.



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Monitoring and assessment of recovery of jewfish (Epinephelus itajara) populations in the eastern Gulf of Mexico.

The general goals for this project are to identify, quantify, and evaluate the quality of essential estuarine habitat for juvenile jewfish *Epinephelus itajara* in southwest Florida, including areas in the Rookery Bay NERR and the Ten Thousand Islands. Progress to date includes documenting and describing the dominant habitat (undercut areas of mangrove islands) of late juvenile jewfish (ca. 1 kg to 20 kg) and conducting the mark-recapture (Jolly-Seber) studies for estimating absolute density, movement patterns, and survival. Density is evaluated through recapture of fish tagged with internal anchor tags and sonic tags. Juvenile absolute density information is being used both to establish time-series abundance patterns and as a basis for classification of mangrove habitat quality. All habitat study sites are pinpointed with differential GPS and incorporated in a GIS database at the NMFS Panama City Lab. Of the 241 juvenile jewfish tagged within three areas in the Ten Thousand Islands of southwest Florida, 89 (40%) have been recaptured within 10 m of their original capture location. Ancillary components of this work include the study of age and growth of late juveniles and verification of annuli (OTC injections) on hard structures (fin spines and rays and scales), the evaluation of food and feeding, and identification of potential predators and associated species.

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My directed research for Rookery Bay National Estuarine Research Reserve produced a resource guide to support the proposed Learning Resource Center exhibits for training, education, and public interpretation of Reserve cultural resources. This guide consisted of four archaeological projects supported by the Department of Environmental Protection. Project I cataloged and inventoried the existing archaeological collections from the Reserve. Project II mapped and described the stratigraphic profiles of two shell mound sites, and produced a timeline of prehistoric and historic chronology of RBNERR and its relationship to other SW Florida sites. Project III tasks produced a resource guide of indexed photographs and slides of selected archaeological sites of sensitive and interpretive potential, as well as established photographic points for future evaluation of coastal erosion and deterioration. Project IV produced a wall map of RBNERR prehistoric and historic sites, identified and developed archaeological themes for exhibits at the Learning Center, outdoor kiosks, and print material for public education.



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Root Production, Vertical Accretion, and Surface Elevation Change in Mangrove Forests

Habitat stability of many wetlands is dependent on a feed-back relationship between hydrology and plant growth. Water movement brings in sediment and nutrients and flushes out phytotoxins, actions that promote plant growth and reproduction. Plant roots not only act to bind newly deposited sediment, but directly contribute to soil formation by adding organic matter to the soil. This feed-back is a natural, ongoing process that allows the wetland to self-adjust to prevailing water levels and is particularly important in allowing coastal marshes to keep pace with rising sea level. If hydrology or other factors affecting root growth change, then the ability of the plant community to stabilize the soil and maintain surface elevations relative to water levels will be altered. The objective of this study is to determine the contribution of surface and sub-surface root production to vertical accretion and surface elevation change in mangrove forests. Surface elevation tables and marker horizons have been installed in different mangrove forest zones at Rookery Bay and nearby locations. Additional SET's will be established to aid in determining effects of above and belowground processes contributing to elevation change. Knowledge of how external factors interact with production (and distribution) of organic matter below-ground will allow managers to better plan conservation and restoration programs for wetland ecosystems.

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Reducing Phosphorous Loads to Lakes in South Florida: Testing an 8-Foot Vegetative Filter Strip

This experimental fieldwork examined the amount of phosphorous removal that an 8-foot vegetative filter strip (VFS) provides compared with that of a non-vegetative plot. Plot studies were conducted using rainfall simulation techniques to investigate phosphorous transport in VFS receiving runoff from a fertilized lawn area during a significant rainfall event. The experimental system consisted of 6 isolated plots along the shore of the stormwater retention pond in Naples, FL. This experiment concluded that among several native species planted in the VFS, spikerush was the most adaptable species and performs well as a water quality BMP. The study also showed that an 8-foot VFS exhibits a 37.5% reduction in total phosphorous for the rainfall event tested.



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Developing a Recreation Management Strategy for Rookery Bay National Estuarine Research Reserve

This study will provide a starting point for RBNERR personnel to manage recreation use as well as add to the understanding of the complex relationship between recreation visitors and coastal environments. Through the use of on-site visitor interviews, research will examine visitors' demographics, motives for recreation behavior, perceptions of environmental and social impacts, participation in recreation activities, and preferences for management. This sociological data will be integrated with spatial information through GIS technology to better apply research findings to the RBNERR management.

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Comparing Application Methods and Herbicides for Control of Downy Rose Myrtle

Herbicides and application methods were compared for control of *Rhodomyrtus tomentosa* (downy rose myrtle). Publications: Stocker, R.K., and J. Possley. 2001. Comparing application methods and herbicides for control of downy rose myrtle. *Ecological Restoration* (Spring 2001—in press).

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To assess water conditions in Florida estuaries before historic modification of the nearby watersheds, pre- and post-modification environmental records of three estuaries within RBNERR were compared. Estuaries in this study vary in their degrees of modification: Blackwater River (least modified), Henderson Creek (moderately modified), and Faka-Union Canal (severely modified). Oxygen isotope compositions recorded in dated oyster shells reflect temperature and salinity fluctuations that occurred over annual and seasonal time scales. Because of the simultaneous effect of temperature and salinity on the oxygen isotope composition of shell carbonate, an independent proxy (Mg/Ca ratios) of temperature is being developed to constrain this parameter. Carbon isotope compositions of oyster shells can be used to infer seasonal fluctuations in primary productivity or change in the contribution of carbon from various sources. The data amassed in this project will estimate baseline environmental conditions. Results will enable watershed resource managers to make informed decisions about restoration efforts in targeted estuaries.



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I have not directly worked on the site, but my Ph.D. research utilized some specimens of the fish Rivulus marmoratus at RBNERR. These specimens were collected by David Addison (my research goals were summarized in a letter to Todd Hopkins, dated Sept. 8, 1997). The project was seeking to compare physical differences between populations of the fish in Florida and across the Caribbean and Bahamas. Essentially, I found that certain physical anomalies noted in collections made several years prior (1993) were not noted in the follow-up collections of David Addison. It would be noteworthy to continue monitoring this population, as I have not seen the types of anomalies observed in 1993 in any other population I have examined. My data are included in my dissertation, which is slowly being published. The citation: Taylor, David Scott. Physical variability and fluctuating asymmetry in Rivulus marmoratus: geographic differences and developmental stability in homozygous and heterozygous populations. Florida Inst. Of Technology. 1999. 192 pp.

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Regulation of Estuarine phytoplankton dynamics: The interaction of reduced salinity, enhanced N:P ratios and pulsed nutrient inputs.

Natural populations of estuarine phytoplankton were grown in dialysis culture under in situ conditions, and in chemostats in the laboratory. Pulsed and continuous additions of nitrate and phosphate, at two different atomic ratios (16:1 and 30:1) were made to determine the effects upon species growth rates, biomass, and community structure. Results of the study offered insights for managers to assess the impact of increased nutrient influx accompanying shoreline development.



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Stomatal frequency response to atmospheric CO₂ increase: natural, modeling and controlled-environment experiments. (1998-2001) and The relation between atmospheric CO₂, solar irradiance and ENSO activity during the last millenium (2001-2006)

Both projects focus on the response of different wetland vegetations to environmental and climatic change. Leaf anatomical / morphological adaptation to (a) changing CO₂ concentrations through time and (b) to El Nino / La Nina related changes in wet / dry conditions are studied in (sub-)fossil Mangrove leaves preserved in the peaty soils of the Mangrove forests at RBNERR. Peat samples have been taken at sites where earlier studies on salinity changes have been performed. RBNERR has been chosen as research area because of its excellent documentation of environmental parameters potentially relevant to our research goals.

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I am an archaeologist and have been working in the Belle Meade watershed area over the last 30 years although I have only been involved directly with RBNERR since 1997. In the summer of 1997 I ran a field school excavating the Shell Island site at the mouth of Henderson Creek (adjacent to the field lab on shell road). This is an important archaeological site relevant to the RBNERR because it contains an environmental history of the water chemistry extending back 1500 years. I also conducted two field schools at the Key Marco Site, 8CR48, and one additional excavation at the site. I have also collected shell artifacts that span 2000 years that contain geochemistry that can yield change in environmental history of the watershed. In addition I have evidence from this site of a higher sea level at 1500 years ago. The paleo-environmental information contained in the stratified, datable sediments from these two archaeological sites holds a key to understanding the history of the Belle Meade watershed discharge as do other archaeological sites in the watershed. Molluscs from these stratified cultural sediments can be used to determine water quality. A further goal of mine and I think this is congruent with the management and research needs of RBNERR is a thorough archaeological survey and assessment of the archaeological resources (i.e. archaeological sites) within RBNERR.



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Investigation of Immature Sea Turtles in the Coastal Waters of Southwest Florida

Information concerning the distribution and abundance of sea turtles in coastal southwest Florida is limited to observations from nesting surveys and strandings. Consequently, the current status of immature sea turtles in southwest Florida is unknown, particularly the highly endangered Kemp's ridley turtle. The purpose of this project is to determine the relative abundance, temporal and spatial distributions, movements, growth, and habitat requirements of immature sea turtles in the nearshore waters of Southwest Florida. Our research efforts focus on the highly endangered Kemp's ridley turtle, but other turtle species are also collected during routine sampling operations. Supplementary research activities will eventually include: collecting blood for sex determination, monitoring local movements via radio and sonic telemetry, and developing a GIS model for analyzing turtle habitat associations. A low-light underwater video camera will be used to map benthic habitats at capture sites. Proposed satellite telemetry would enable us to monitor longer-term seasonal movements of Kemp's ridley turtles as they move along the southwest Florida coast.